NOAA's National Climatic Data Center

U.S. Climate Reference Network (USCRN): Soil Climate Measurements

Michael Palecki
NCDC/NESDIS/NOAA
Jesse Bell
NOAA CICS-NC

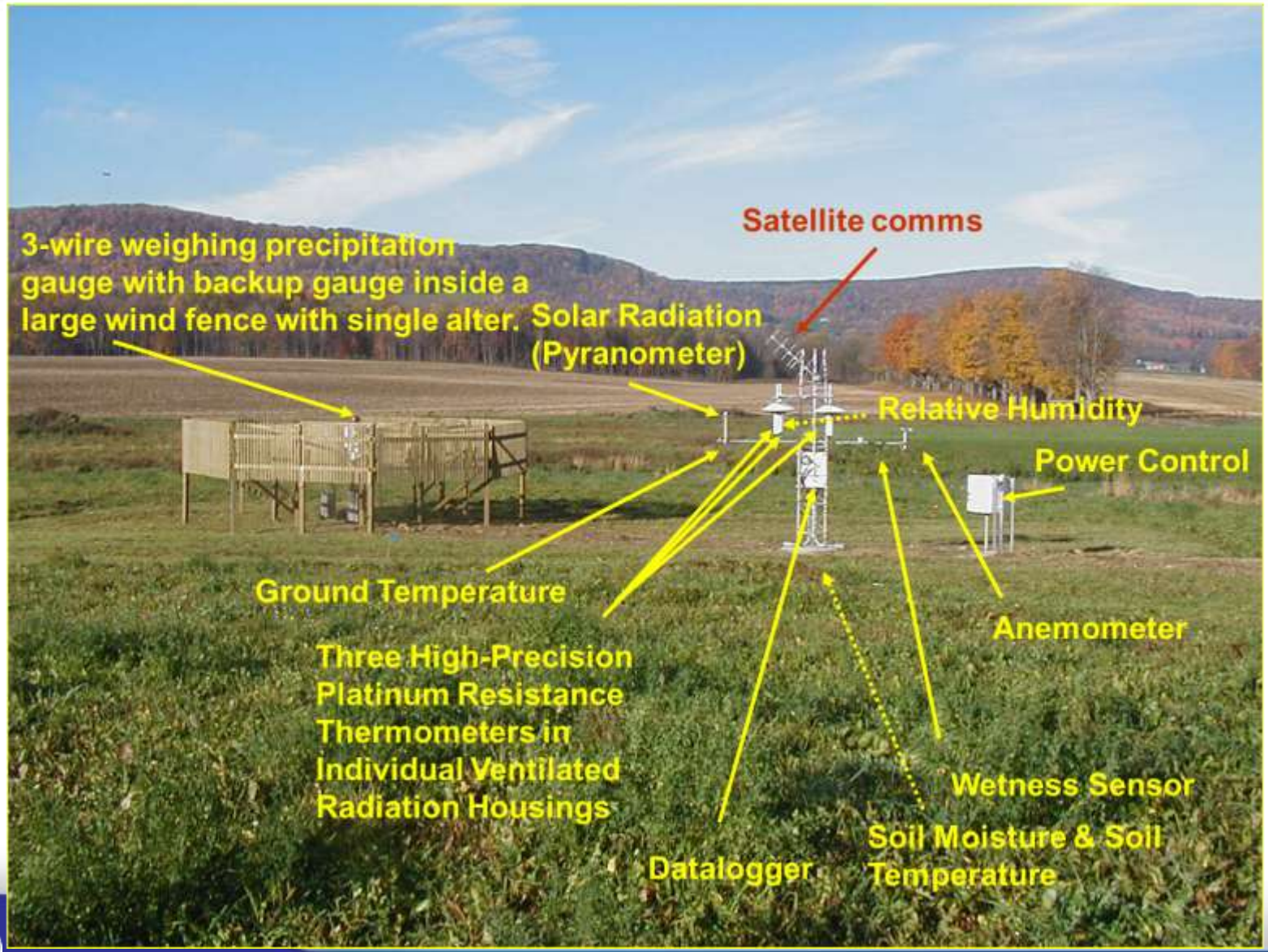
Outline

- U.S. Climate Reference Network Introduction
- Primary USCRN Purpose:

  National Climate Change Observations in Stable Environments Over Many Years
- Utility Beyond Climate Change Studies:

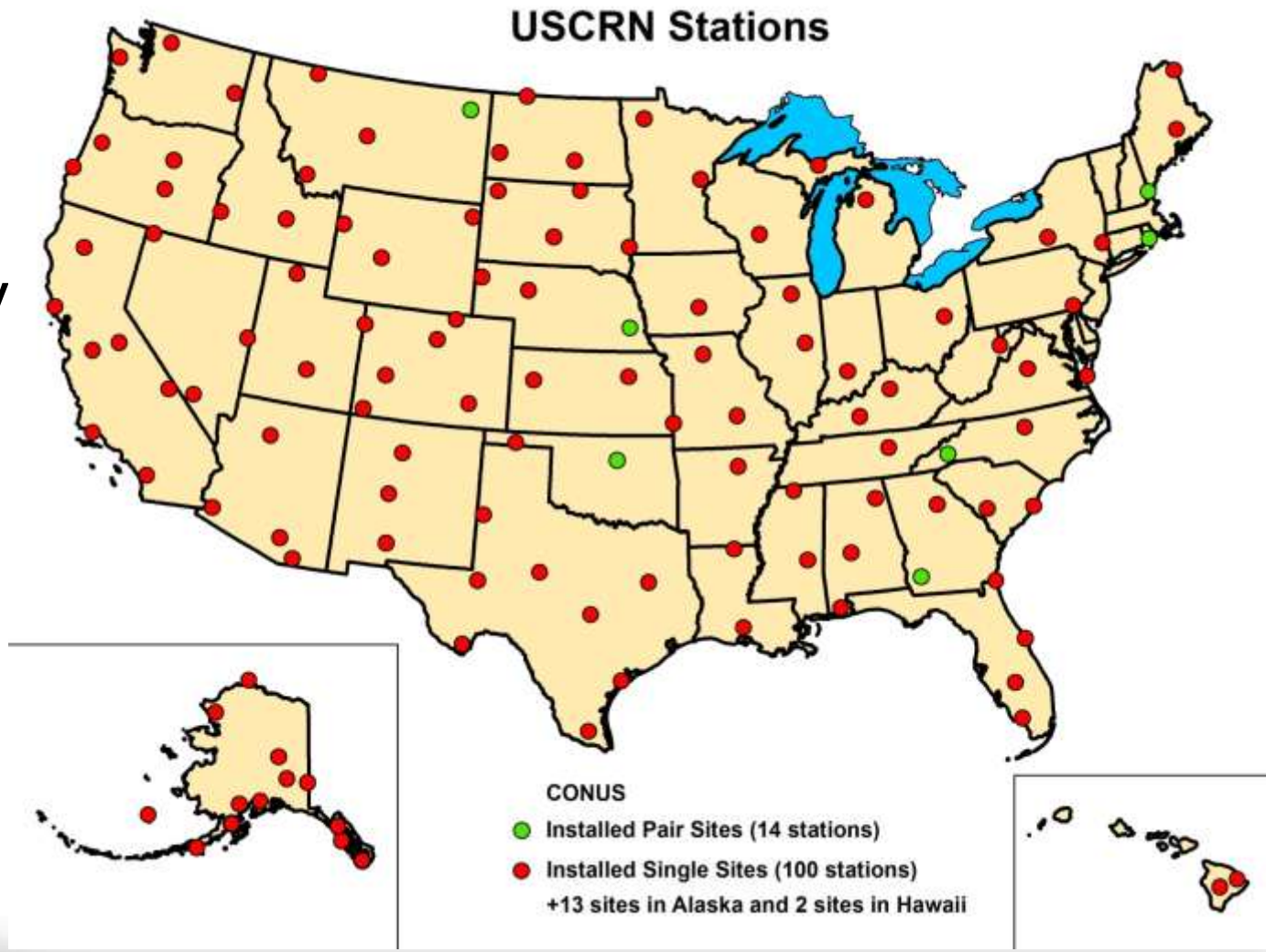
  Applications of Soil Moisture and Temperature Observations to Drought Monitoring

USCRN Station: Ithaca, NY



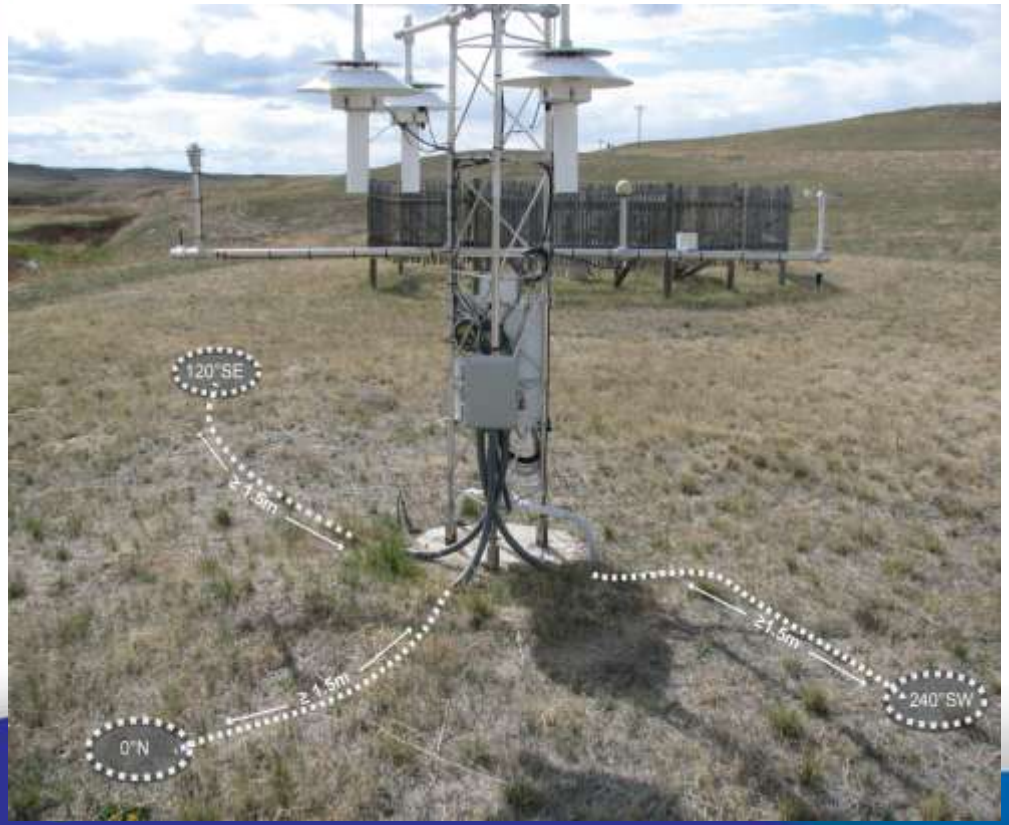
USCRN Distribution

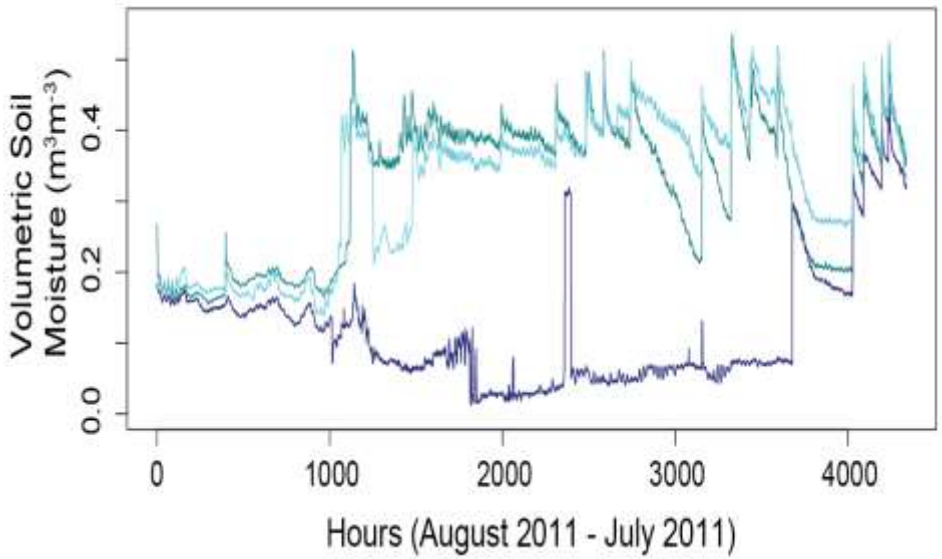
USCRN is a low spatial resolution but high accuracy network for U.S. climate change detection



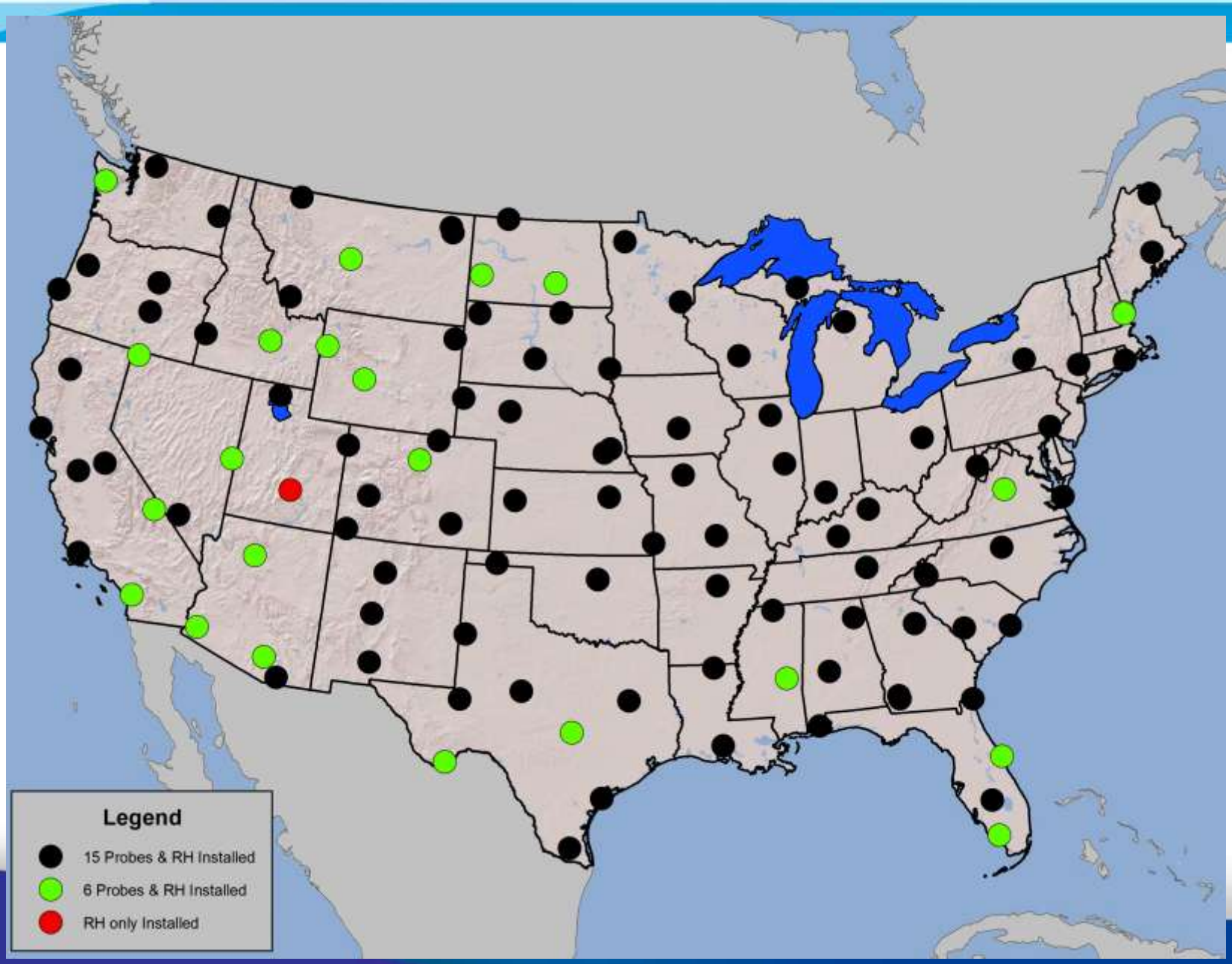
Key Attribute: Triplicate Measurements

- Three independent measurements take place around stations at each level
  - Continuity – record intact if a probe fails
  - Quality – intercomparison of observations





Soil Probe Depths Vary With Location
Generally are 5, 10, 20, 50, & 100 cm



Soil Moisture and Temperature QC

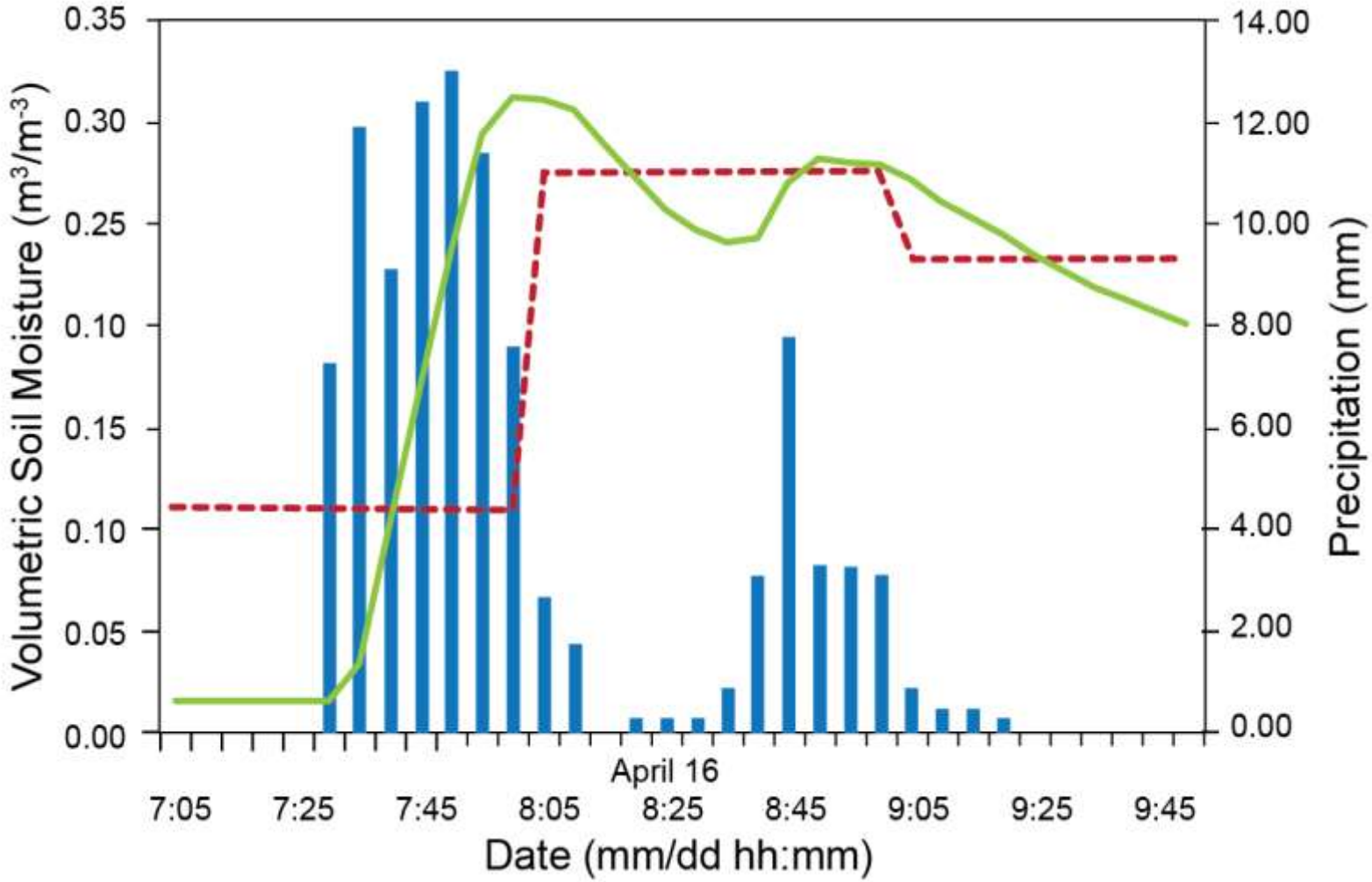
- SM and ST range flagging – dielectric or temperature beyond feasible range
- SM temperature flagging – soil moisture is not measured in frozen ground < 0.5°C

- Manual incorporation in Bad Sensor List:
  - Statistical results and visualization graphics are manually examined monthly to see if a probe is not operating well, either due to equipment issues or incompatibility with site soil

High-resolution Observations

- Prior to 2012, all soil moisture/temperature measurements were hourly averages; soil moisture at 10 cm and lower remain hourly
- Starting in 2012, USCRN global solar radiation, IR surface temperature, 1.5 m wind speed, and 5 cm soil moisture/ temperature are also available at 5-minute resolution, along with air temperature, relative humidity, precipitation, and wetness

5-Minute Soil Moisture - Green Line



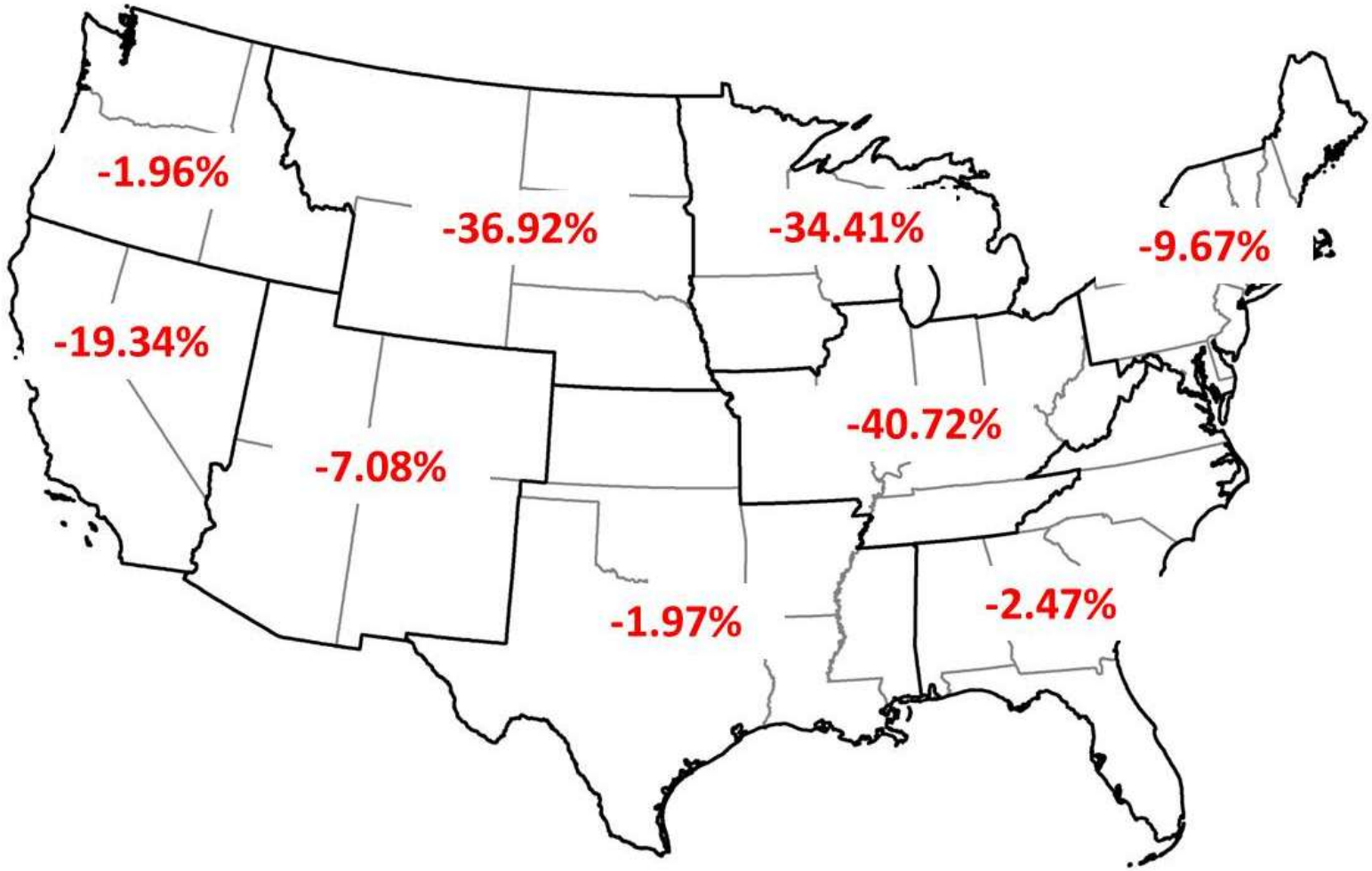
USCRN Soil Moisture

- Applications
  - Drought monitoring
  - Satellite validation
  - Model input and/or verification

- Issues
  - Short time history
  - Coarse network
  - Spatial representativeness
  - Absolute accuracy

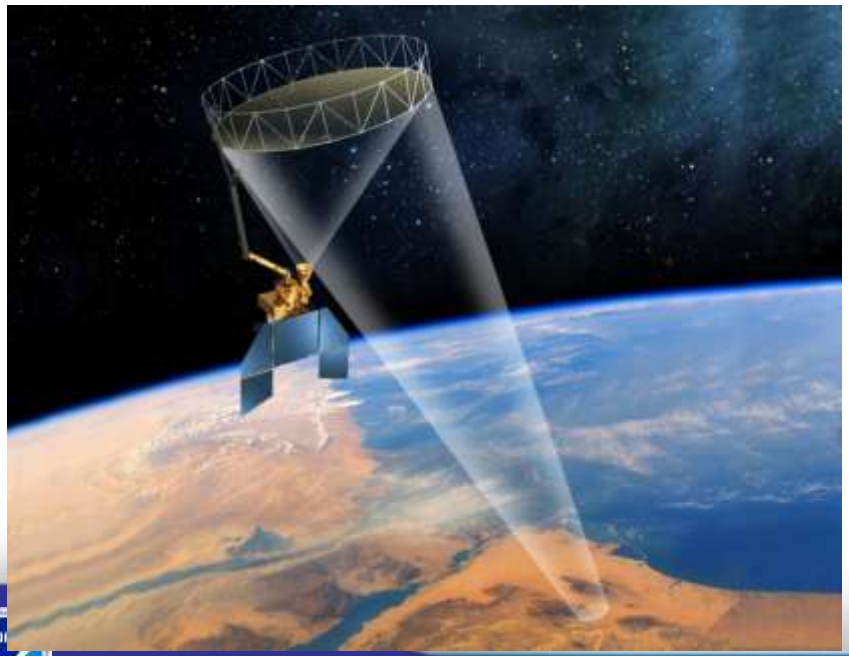
Drought Applications – Change Over Time

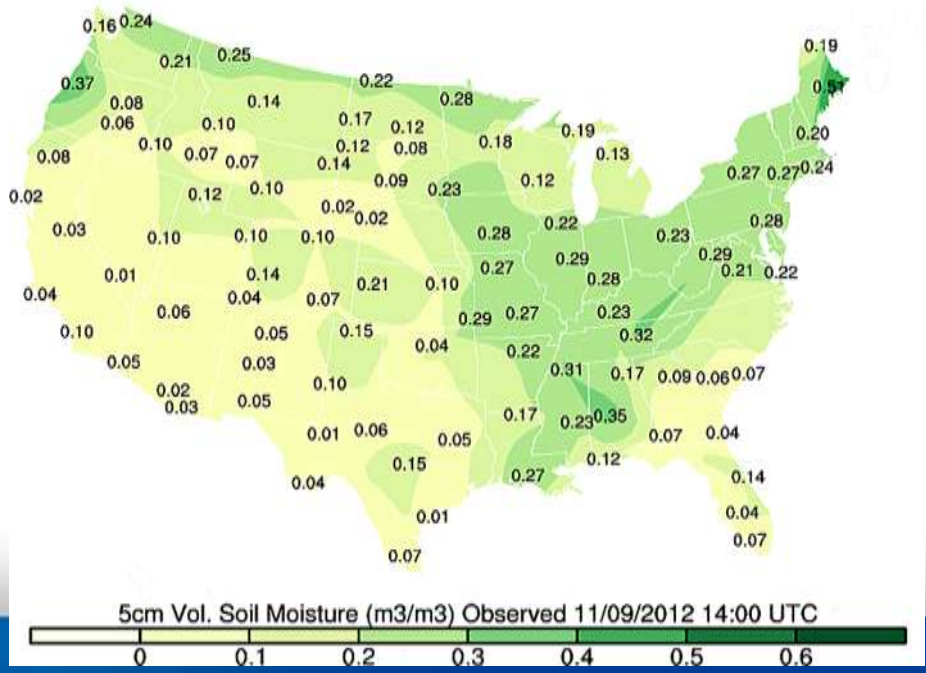
Percent Differences by Climate Region Between 5-cm soil moisture in July 2011 minus July 2012



Soil Moisture Active Passive (SMAP) Satellite Mission Partner

- USCRN working to better calibrate a subset of surface soil moisture measurement sites
- USCRN will participate in at least one full SMAP cal/val test bed, and otherwise will be a coarse network validator

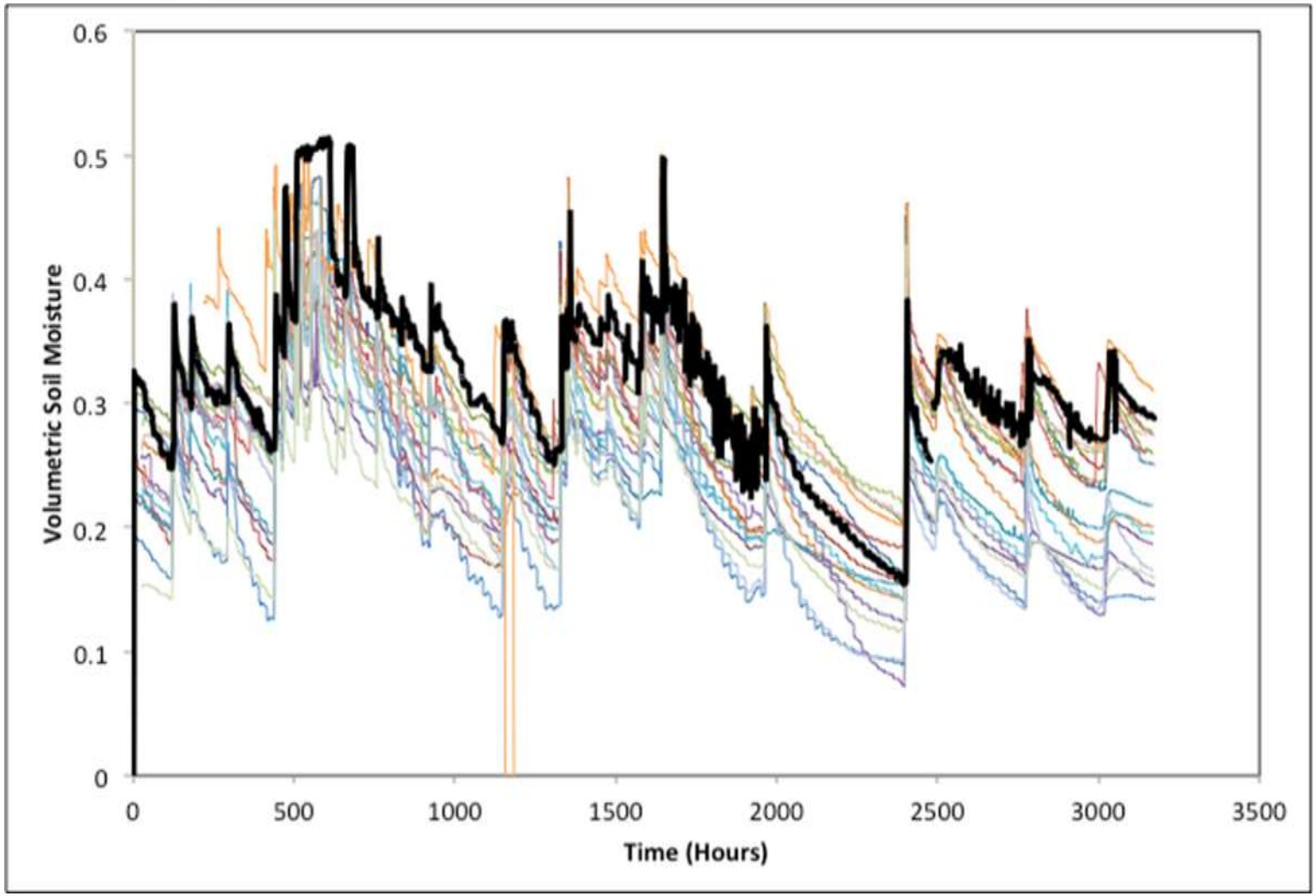




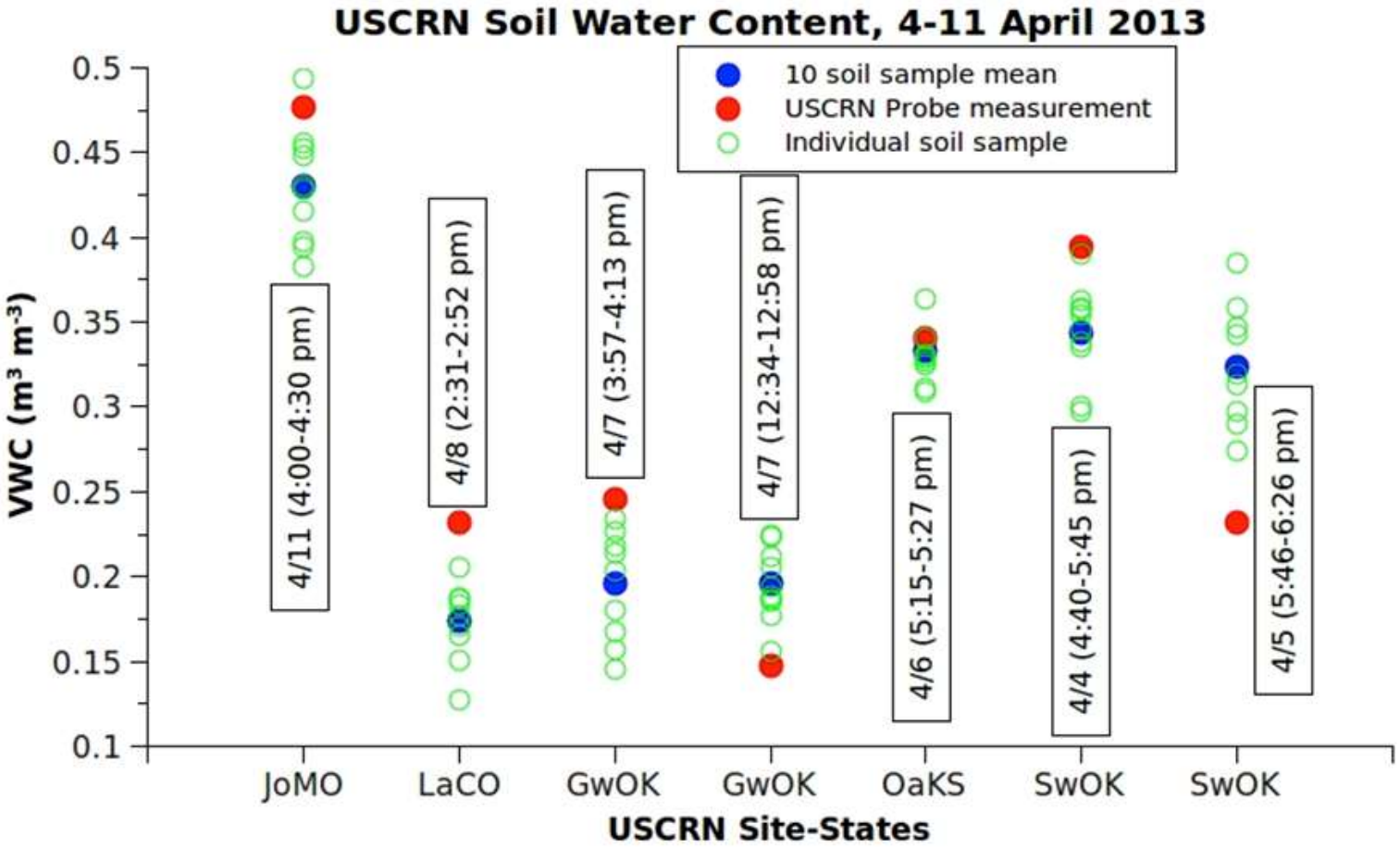
Spatial Representativeness Studies

- Two USCRN sites so far: Millbrook, NY, and Crossville, TN (with Michael Cosh, USDA, & other collaborators)

5-cm Soil Moisture at Crossville



5-cm Gravimetric Sampling at Sites: Absolute Accuracy of USCRN Values



Thank You!

http://www.ncdc.noaa.gov/crn/
http://www.ncdc.noaa.gov/crn/products.html
http://www.ncdc.noaa.gov/crn/visualizations.html

US Climate Reference Network

Recent Publications

- Diamond, H.J., T.R. Karl, M.A. Palecki, C.B. Baker, J.E. Bell, R.D. Leeper, D.R. Easterling, J.H. Lawrimore, T.P. Meyers, M.R. Helfert, G. Goodge, and P.W. Thorne, 2013: U.S. Climate Reference Network after one decade of operations: status and assessment. *Bull. Amer. Meteor. Soc.*, doi:10.1175/BAMS-D-12-00170.

- Bell J.E., M.A. Palecki, W.G. Collins, J.H. Lawrimore, R.D. Leeper, M.E. Hall, J. Kochendorfer, T.P. Meyers, T. Wilson, C.B Baker, H.J. Diamond, 2013: U.S. Climate Reference Network Soil Moisture and Temperature Observations. *J. Hydrometeorol*., doi:10.1175/JHM-D-12-0146.1.

- Palecki, M.A., and J.E. Bell, 2013: U.S. Climate Reference Network soil moisture observations with triple redundancy: Measurement variability. *Vadose Zone Journal*, doi:10.2136/vzj2012.0158.